Association at Chicago by a San Francisco research laboratory. The findings of Drs. Rosenman and Friedman were based upon studies with 42 male tax accountants. Blood cholesterol samplings were taken during three periods of stress and three of relative inactivity. The results, which showed maximum blood cholesterol under stress in 83 per cent of the group and minimum counts during lulls for 75 per cent of the group, are looked upon as certain evidence of the importance of mental tension on coronary disease. "Even more striking was the highly significant acceleration of blood clotting time." Under stress the average time was five minutes as against 9.4 minutes when the accountants were under minimum stress. This report also bears out once again the close relationship between thrombo-embolism and blood cholesterol levels.

There are those who contend that fat consumption in this country has not gained in the past thirty to fifty years—the change is rather one of impossible calculations. It will also be argued that coronary disease has not increased—we simply have better statistics and more accurate knowledge as to causes of death. Whether gaining or not, atherosclerosis is still the long leader in the cause of death in this country and among other populations. It behooves all of us, therefore, to avoid creating public hysteria and to encourage continued orderly research now so well started.

Weather and Caribbean Fisheries Development

RICHARD T. WHITELEATHER and JAMES B. HIGMAN

U. S. Fish & Wildlife Service
Washington, D. C.

THE WEATHER is one of the great controlling factors in marine fisheries commercial production. Weather is made up of a combination of conditions of air, temperature, moisture, wind, sky and cloud formations at any given time and place. For the purpose of this paper we will apply the term "weather" mainly to wind and its effect on sea conditions in fisheries development. Winds and choppy seas are assets under some circumstances in fishing gear operation. For fishing vessel operations such conditions are another matter. They can result in anything from a mere inconvenience to a genuine hazard for small vessels. In fact, it has been said that the sea is almost always rough for small ships. This axiom holds true in the Caribbean Sea as in other open waters for fishing vessels, which most generally fall into the class of small ships.

In recent years there has been considerable fishery developmental activity in the Caribbean, where small ships play a part. United States Government exploratory fishing vessels have been working with some success in the area to evaluate the potentials of tuna and other latent offshore fisheries. Japanese vessels, under various types of cooperative arrangements with some of the local Caribbean governments, are also exploring the Caribbean and adjacent waters. In addition to this, substantial local effort is being placed on pushing the historically inshore fisheries outward from Island shores. A large tuna cannery has been established at Ponce, Puerto Rico. Most of the raw material used at this cannery is derived at present from the Pacific. However, this installation has perhaps given greater confidence to a developing market for Caribbean produc-

tion. With interest mounting in fishery development in the open Caribbean, some knowledge of the weather and its effect on sea conditions seems valuable for those who venture their capital there.

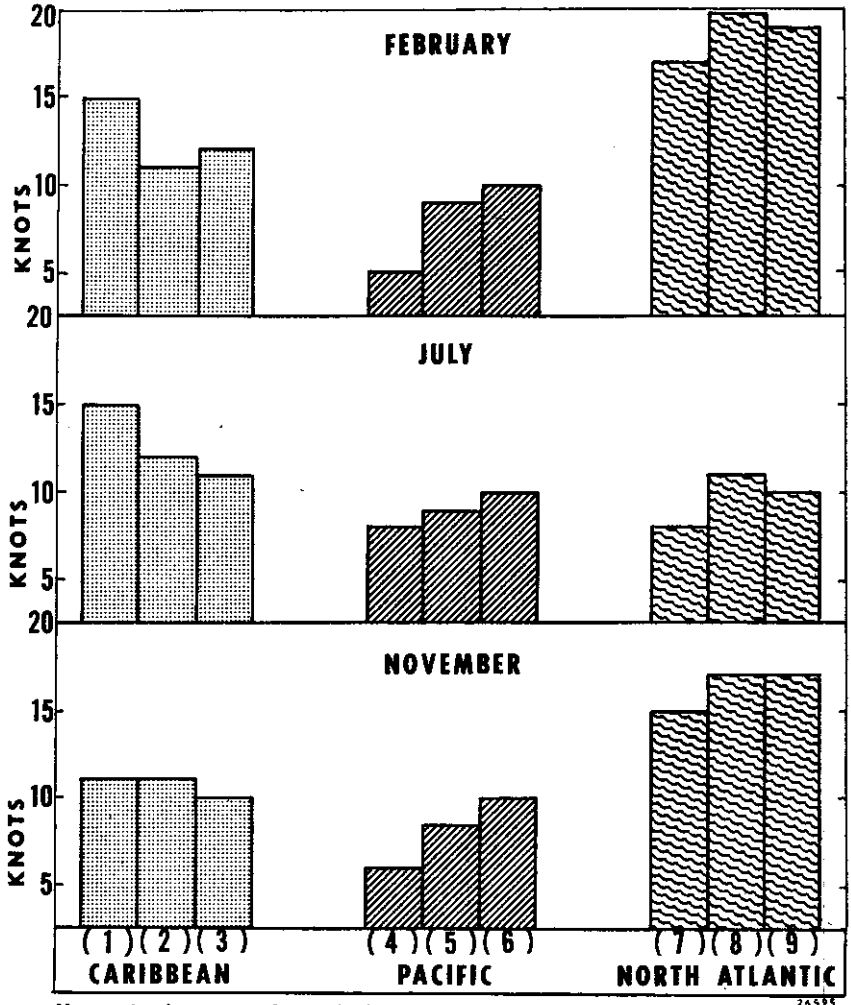
In general, the Caribbean is blessed with clear weather. Fog, sleet, snow, and overcast of any consequence are practically unknown in this sub-tropical area. Because of the pleasant climate which prevails, and because of the many glamorous descriptions written in travel brochures and other publications, there is some tendency to think of the Caribbean as a large and placid blue-water ocean lake. Although this is close to being a fact, insofar as most elements of the weather are concerned, there are wind conditions which should be recognized for their effect on fishery operations. The significance of so doing can be readily understood from accounts of difficult passages from the Panama Canal eastward across the Caribbean as experienced by some Pacific tuna vessels in delivering fish to the cannery at Puerto Rico. These craft, among the largest in our fishing fleet, are fairly able and are designed to cope with usual sea conditions, even when loaded. Some of these vessels have encountered heavy going off the Gulf of Darien in the southwestern Caribbean. One freezer vessel with 600 tons of tuna aboard was lost during a February gale in 1955 (Anonymous, 1955). These are extreme conditions. Nevertheless, they point up the need for caution during certain parts of the year and in certain sections when winter gales or northers are apt to set in rapidly and in the late summer when hurricanes develop. At times there also are the usual thunder squalls found in the lower latitudes, but these, even though violent, are of short duration. On the other hand, April and May are the most tranquil months in all parts of the West Indies when the finest weather and smoothest seas are experienced (Anonymous, 1951).

As well as it may be to have an awareness of such conditions, our principal interest with respect to fisheries is in the average kind of weather likely to be found in the area throughout the year. The northeast trade wind is the dominant factor from this standpoint. In spite of its name, the northeast trade normally blows more from an easterly direction, even at times from the southeast in some parts of the Caribbean. This wind is very dependable at all seasons over the passages from Puerto Rico to Jamaica, but sometimes is interrupted by northerly winds in the cooler months and briefly though violently disturbed by tropical cyclones which pass through during the warmer seasons, as mentioned earlier herein (Anonymous, 1951).

On the coast of the large islands at places most exposed to the direct flow of the trade from the open sea, the land and sea breeze influence is seldom of sufficient strength to overpower the prevailing trade wind. However, it becomes evident in a very noticeable daily variation of wind force which appears as a considerable increase in wind velocity at mid-day and a decrease during the night. This may account for the belief that the trade wind is stronger in the West Indies than in most parts of the world (Anonymous, 1951).

The effect of these easterly winds is a choppy sea that sets up during the daylight hours, particularly around mid-day and afternoon. These effects, of course, vary, depending upon the direction of the current. In such places as the Gulf of Darien, where there are currents contrary to the general westerly flow of Caribbean waters, confused seas can build up that make fishing from a small vessel next to impossible and sometimes even dangerous. There is testimony on this from personal experience while bound from Colon, Panama to Trinidad on an eighty-five-foot purse seiner. At that time the windows in the pilot house of the

Average Wind Velocities Certain Months



Numerals show areas from which data derived:

1 - East of Panama
2 - South of Puerto Rico
3 - West of Grenada
4 - Galapagos Is.
5 - Clipperton I.
6 - Guadelupe I.
7 - Georges Bank
8 - Sable I.
9 - Grand Bank

vessel were stove-in by heavy seas and only fifty-two miles were logged in the first twenty-four hours off the Gulf of Darien.

However, in most regions, although seas begin to make up to some extent with the freshening of the winds every day, the waves usually run in a more uniform direction. The sea is not rough enough to be dangerous for a small craft but, unless a vessel has good sea-keeping qualities, the handling of fishing gear is awkward, time-consuming and frequently not too productive. This is a definite

consideration to be reckoned with in the type of fishing that requires the vessel to be hove-to while setting and hauling back gear, but not so much in trolling operations.

In fact, one can look for medium seas (three to eight feet) more than fifty per cent of the time even in August in the 10-20 degree northern latitudinal belt in which the Caribbean lies (Bigelow and Edmondson, 1947). This accords with the average trade wind velocity of 12-16 knots.

This means that small craft fishing the open Caribbean should be well enough founded to operate in seas of something between three and eight feet in height or otherwise lose perhaps half of their fishing time. On the other hand, the occurrence of high seas (over eight feet) is fairly infrequent (zero to eight per cent of the time) during the same month. The balance of the time, of course, represents a substantial percentage of low-sea days (zero to three feet)—a delight to any fisherman.

High seas are somewhat more frequent in the Caribbean during January and February than in August, which corresponds to the fact that the trades average slightly stronger in the winter than in the summer. Even so, the number of low seas is about the same in one season as in the other. The sea, too, is usually smoothest under the shelter of the Lesser Antilles, of the Virgin Islands, Puerto Rico, Hispaniola, Jamaica and Cuba and roughest in the down-wind parts of the Caribbean off the coast of Colombia, Costa Rica, and Nicaragua, in winter as well as summer, which is to be expected since the trades here have an effective fetch of 350 to 375 miles (Bigelow and Edmondson, 1947).

Some idea of fishing weather in the open Caribbean can be gained by comparisons with wind conditions in other fishing areas, as shown in chart on page 145. (Anonymous, 1945).

The areas on the chart for which data were analyzed were selected purposely for comparison of the Caribbean with certain well known commercial fishing areas. California tuna vessels operate in the general region indicated for the Pacific. New England groundfish trawlers work in the areas chosen in the North Atlantic.

There are at least three rather interesting things shown by the data in this chart on wind velocities. First, it is apparent that the Caribbean average wind velocity in each of the months considered is rather uniform in comparison with the North Atlantic areas chosen, but not as uniform as in the particular areas on the Pacific side. Secondly, the average velocity in the Caribbean is substantially greater than in the Pacific, where most of the commercial tuna vessels ply their trade. Thirdly, it is somewhat surprising that in the month of July—representing the summer period—the Caribbean wind velocities, especially in the western parts, are greater than in the North Atlantic areas from which data were taken.

To get an indication of the frequency of occurrence of Caribbean wind velocities in the higher ranges, additional analysis has been made from the Pilot Chart for the month of July. Off Panama, 67 per cent of the time winds ranged from 16-18 knots; off Puerto Rico, 78 per cent of the time, 18 knots; and off Grenada, 81 per cent of the time, 11-12 knots. In the same month, in the North Atlantic—rather conventionally assumed to be rougher—54 per cent of the observed wind velocities were between 8-13 knots. It should be emphasized here that no sweeping statistical analyses have been made. The data are sufficient, nevertheless, to show that the average every-day Caribbean wind conditions,

even in summer, can be inconvenient for small boats—unless properly designed —and a handicap to their gear-handling operations.

There is an old adage, reminding us that it's an ill wind that blows no one some good. This can be aptly fitted to the Caribbean, because the winds and choppy seas, which have been mentioned as bothersome in small-vessel operations, actually are benefical in fishing longline gear. From experience so far, it seems most likely that longline gear will be the principal, and probably the most productive device used in the open Caribbean for the development of fisheries for tuna and tuna-like species. There is rather good reason to believe that this gear fishes far more effectively at times when there is surface wave action.

On the basis of preliminary examination of results of 175 longline sets, made in the Gulf and Caribbean during exploration by the vessel OREGON, catches in moderate seas were 35 per cent better than in calm seas. Catches in heavy seas were 23 per cent better than in calm seas. We are not certain as to the reasons for this. Perhaps the surface waves create enough longline movement so that the baits are more active and, therefore, more attractive to the fish; perhaps it is the agitation of the water which churns up the general food supply. One thing we know for certain is that the wind and the waves are factors to be considered in Caribbean fishery development.

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The Lobster Fishery of Puerto Rico

CARMELO FELICIANO

Puerto Rico Department of Agriculture and Commerce
San Juan, P. R.

Introduction

THE SPINY LOBSTER, *Panulirus argus* Latreille, has a considerable local importance to both the commercial and sport fisheries of Puerto Rico. The commercial landings are worth around $100,000 per year to the fishermen, and according to Erdman and Zalduondo (1956), records of 37 spearfishing trips collected at the port of Joyuda showed that this species represented 43 per cent of the catch by number and 16 per cent of the catch by weight of the sport spearfishermen landings. The increasing demand for this item has made necessary its importation from other countries.